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BOOKPLATE RECOGNITION WITH BIOMETRIC TECHNIQUES

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ABSTRACT

This paper analyses bookplates, their source and history and discuss the feasibility of applying biometric technology, especially fingerprint recognition, as a tool to provide engraving identification in a database, strengthening the process of piece recognition.

Keywords: Bookplates; Fingerprints; Image Recognition; *Ex Libris*; Biometry.

1 INTRODUCTION

Images are important when identifying an era and its historic range, as are literary texts and oral testimony (BURKE, 2004). As far as written records are fundamental to understand an historic period, images allow for nations and nationalities representation because their social contexts, economic and technologic behavior are represented by them. According to this idea, it is possible to use images – here represented by bookplates – as an element to understand an era. Due to the complexity of image recognition, this study explores the possibility of developing a tool with enough capacity to identify, organize and disclose iconographic collections. The selection of biometric techniques occurs based on the similarity between engraving and the lines and texture in fingerprints. The possibility of applying biometric technology to image, line and shape recognition will show a way to indicate similarity or equivalence of bookplates, helping in studies of authoring and technique identification, representing an advance in the iconographic treatment of digital or textual documents.

2 BOOKPLATES

Bookplates are stamps, usually engraved in paper, which are applied to the inside cover or to the first book sheet, showing the owner of the copy. The Latin

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expression *ex libris* (bookplates) means “among the books of,” or “from the library of,” representing the publication property title (MARTINS FILHO, 2008). As bookplates represent the possession of a book, its drawing might be personalized and this contributes to the identification of the owner. Personal characteristics, information that allows identification of the owners, the owner’s preferences or the use of emblems are all elements present in the drawing and such idealization aims at expressing by images, the personality and the owners’ craving (MARTINS FILHO, 2008). As it usually shows the owner’s name, the ownership identification is not difficult. On the other hand, both engraver identification and engraving dates demand studies, which seldom support accurate attribution of such elements.

2.1 Origins and History

Although its origin is not specified, there are owners’ possession records since the Ancient History, dating from 1400 b.C. (MARTINS FILHO, 2008). In the middle ages the nobles drew arms in their manuscripts and books, picturing their ensigns, monograms or slogans of individuals or families, institutions and corporations (MARTINS FILHO, 2008). Multiple ways of signing ownership of a book were used but the forms we know today can be traced back to the Renaissance. With diffusion of typography and appearance of press, book production changed and this movement impact deeply the way books were signed as well. With the availability of books, ownership was not restrict to nobles anymore and consequent increase of private libraries, the ownership symbol engraving begun to be made in detached sheets which were applied to the books, usually on the inside cover. The simplest drawings were made with typographic techniques, while the most elaborated ones were based on engraving techniques, specially xylography or metal engraving (MARTINS FILHO, 2008). From the XIX century on – when it started to be studied and collected –bookplates became more than just an instrument to label the books and acquired value. *Exlibristas* are the collectors, scholars and amateurs who get the stamps, write about it and establish criteria to identify and set a value to the stamps.

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With serial manufacturing, there was a decrease in the collection processes followed by a decline in both commercial and artistic values.

2.2 Engraving

Bookplates are usually made based on an engraving process. The most important techniques used are zincography (metal), xylography (wood), lithography (stone), the use of acid (hard ground etching and aquatint), etching, and the use of burin – a tool which is a square tool-steel rod, sharpened diagonally at one end, such that the prominent corner becomes an effective and controllable cutting edge (ESTEVES, 1954). In the hard ground etching, the engraving is a result of the cut made in a material with chemical reagents, removing the metal, rather than cutting into the surface with a tool, causing accidents or irregularities on the surface when making images or letters. The method starts with a layer of wax being applied to the flat metal plate. The desired image is drawn through the wax using a sharp metal tool. Once the drawing is complete, acid is applied to the surface and it acts over the plate, guided by the lines drawn through the wax, producing lines and fissures. Images productions are made by press, by transferring the image to a support (DASILVA, 1976). The aquatint is used to achieve a broad range of tonal values. The technique consists of exposing a copperplate to acid through a layer of melted granulated resin. The acid bites away the plate only in the interstices between the resin grains, leaving an evenly pitted surface that yields broad areas of tone when the grains are removed and the plate is printed. An infinite number of tones can be achieved by exposing various parts of the plate to acid.

3 BIOMETRIC THECNIQUES

Biometric (from the Greek “bios” = life and “metron” = measure) is the science branch focusing on the measurement of living agents, according to physical and behavioral characteristics. Examples of physical characteristics are fingerprints, iris, retina and hand, while behavioral characteristics can be measured by calligraphy, voice and digitations patterns etc. (SÁ, 2006). Biometric systems often

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work based on comparison of two samples: the reference one (storage in a database) and the entrance (retreated at the moment of recognition). A recognition system creates a discriminatory range (score) resulting if the comparison, without prejudice to the generality, diverging from 0 to 1. If closer to 0, more similar the samples are, suggesting that they belong to the same person (SÁ, 2006). This paper explores the biometric technique applied to fingerprints.

Fingerprint recognition allows for identification of lines and textures present in bookplates engraving. Increasing the aim of algorithms application, this work focuses on the possibility of shape and images recognition, which allows for the identification of formats, drawings or authorship of the stamps.

3.1 Fingerprints

Fingerprint analysis is applied for more than a century and it is, currently, one of the most popular biometric techniques. Although few variations may occur from childhood to adult phase, trace, drawing patterns and shape characteristics do not change. Cuts and burnt can temporally modify the drawings, but the shapes converge back to the original format (SÁ, 2006).

Fingerprints' predominant characteristic is the ridge lines and valleys, where the ridge lines are the elevated lines, the black zone, and the valleys are the clearness areas. Ridge lines and valleys usually walk in parallel, sometimes bifurcating or terminating. When analyzed in a wide way, fingerprints patterns show one or more regions where the lines take over distinct shapes – singularities – that can be classified in three typologies: (a) loop, (b) delta and (c) whorl (MALTONI, 2003). The five most usual fingerprint classes are: (a) loop, (b) right loop, (c) whorl, (d) arch and (e) tented arch.

Fingerprints can be defined by their global and local characteristics. At the global level, the pattern assumes distinct shapes in one or more areas, such as frequency, orientation and curvature. The global characteristics are nucleus singularities and delta. The local characteristics are found in minutiae, ridge discontinuous, such as terminations and bifurcations (SÁ, 2006). After the minutiae

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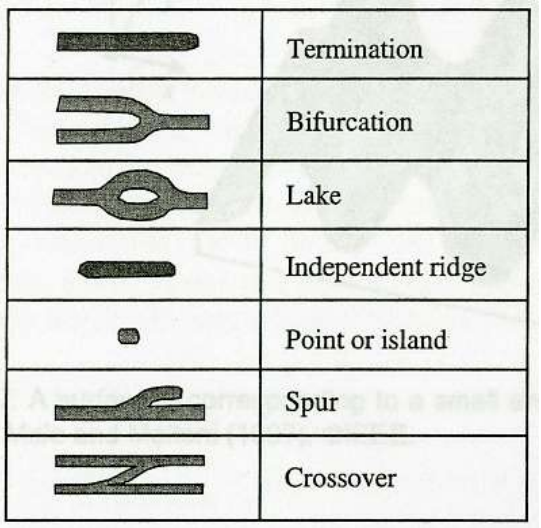
extract – from algorithms – the distance between the dots is calculated. The minutiae were defined by Francis Galton (1822-1911) based on the following classification: (a) termination, (b) bifurcation, (c) lake, (d) independent ridge, (e) point or island, (f) spur and (g) crossover (MALTONI, 2003).

Figure 1: Minutiae classification.



Source: Maltoni – 2003.

After the image digitalization, filters are used to help with the cleaning, extracting noise – degradation, deforming or imperfection -, and bottom information. The images are transformed from silver tone to binary (two tones, usually black and white), preserving the fingerprints details. The main minutiae are marked by connected lines, forming a draft (polygon method), which determines the unique pattern in each fingerprint, allowing the comparison and, consequently, the sample recognition. Fingerprints can be identified by three methods: (a) correlation comparison, (b) minutiae or (c) line characteristic. In correlation comparison the images of two fingerprints are imbricate and the existing pixel correlations are analyzed by different ranging. The minutiae comparison consists in finding a graphic alignment of the dots between two images where the biggest minutiae numbers are coincident. The lines and traces characteristics are analyzed in the pixel intensity and the minutiae position in the fingers' traces (MALTONI, 2003). The result is a consequence of the algorithms application and the existing sample comparison in database. After finding similarity between the image and the reference sample, it is

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possible to establish the pattern similarity and, consequently, promote the image recognition.

4 USING BIOMETRIC TO IDENTIFY BOOKPLATES

Fingerprint is a type of engraving because it is the transference of the existing drawing in finger epidermis' to surfaces through pressure or using ink, powder or the skin grease. Considering this similarity, it suggests that it is possible to apply the fingerprint recognition techniques as an instrument to facilitate the artistic engraving recognition.

In bookplates image retrieval, the difficulty of sample capture is not present because the image digitalization occurs in a controlled environment without the pressure, rotation, sweat, unclean or other external elements that may difficult or compromise fingerprint capture. In content image recognition, several research alternatives are possible: by textual attribute (using words to describe the image content); based on pictorial characteristics (collecting color, textures and shapes information); or using an image-based sample (the image in a database will be used as an example to comparison with new samples).

According to Azevedo-Marques (2002), the use of the texture attribute to identify image content is very pertinent. The texture examination consists in pixels intensity distribution, as its special position, where it is possible to evaluate the probability of the pattern frequency when similar values are detected. One or more image fractions (that contains a lot of information) may be selected and the minutiae analyses starts and a line is traced (polygon method). With the engraving trace done, the system will access the database looking for similar examples. Even if it is not possible to get unrestricted precision – even though the engraving in the same drawing is not completely equal – the tool will allow research alternatives or images with high similarity in the database.

The proposed method accepts a concept that the engraving characteristic comparison will be defined when the polygon is traced in an image fragment that contains relevant information, identifying the minutiae and the texture patterns and

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traces' deepness. These fragments will be analyzed and submitted to an image-sample database comparison. The bookplates image capture process might be done in high resolution to capture the maximum information and image's details as possible. After digitalization, the image is recorded in the database with the known information (metadata): owner, engraving technique, engraver, impression date, colors, dimensions, drawing, shape description and other characteristics identified in the primary source and in researches. Every sample will be analyzed, looking for similarities in the database. If it is not possible to identify the analyzed image, it will be added to the database as a new reference entry. As a matter of fact, the research will not be precisely exact because it is not possible to rely on mathematical accuracy in this analysis as engraving is a human activity and it is liable to artist's physical and emotional intensity when created.

As the database receives more and more images, the retrieval process turns out to be slow, due to database size or complexity of working with samples in high definition and, consequently, big and heavy files. The possibility of applying filters to minimize the sampling that will be analyzed by the system may contribute to enhance the speed of the answers, since it is possible to determine some parameters to limit the pieces that will be compared with the new image or its fragment. If a bookplate shows an owl image, for example, and we inform the system that only the images of owls must be analyzed, it is possible to speed up the process, once the database will compare only the selected samples.

Defining existing minutiae, their traces, lines, geometric shapes and draws can be done previously. The system can work with shapes and draws' templates and perform the bookplates representing elements tracing in advance, which will enhance the sample identification while including them in the database.

Next, representations of Floriano Bicudo's bookplates, their minutiae definition and the comparison between the sample-images present in the database.

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Figure 2: *Ex Libris* Floriano Bicudo: definition of minutiae and comparison with images.

(A) (B) (C)

(D) (E) (F)

(G) (H) (I)

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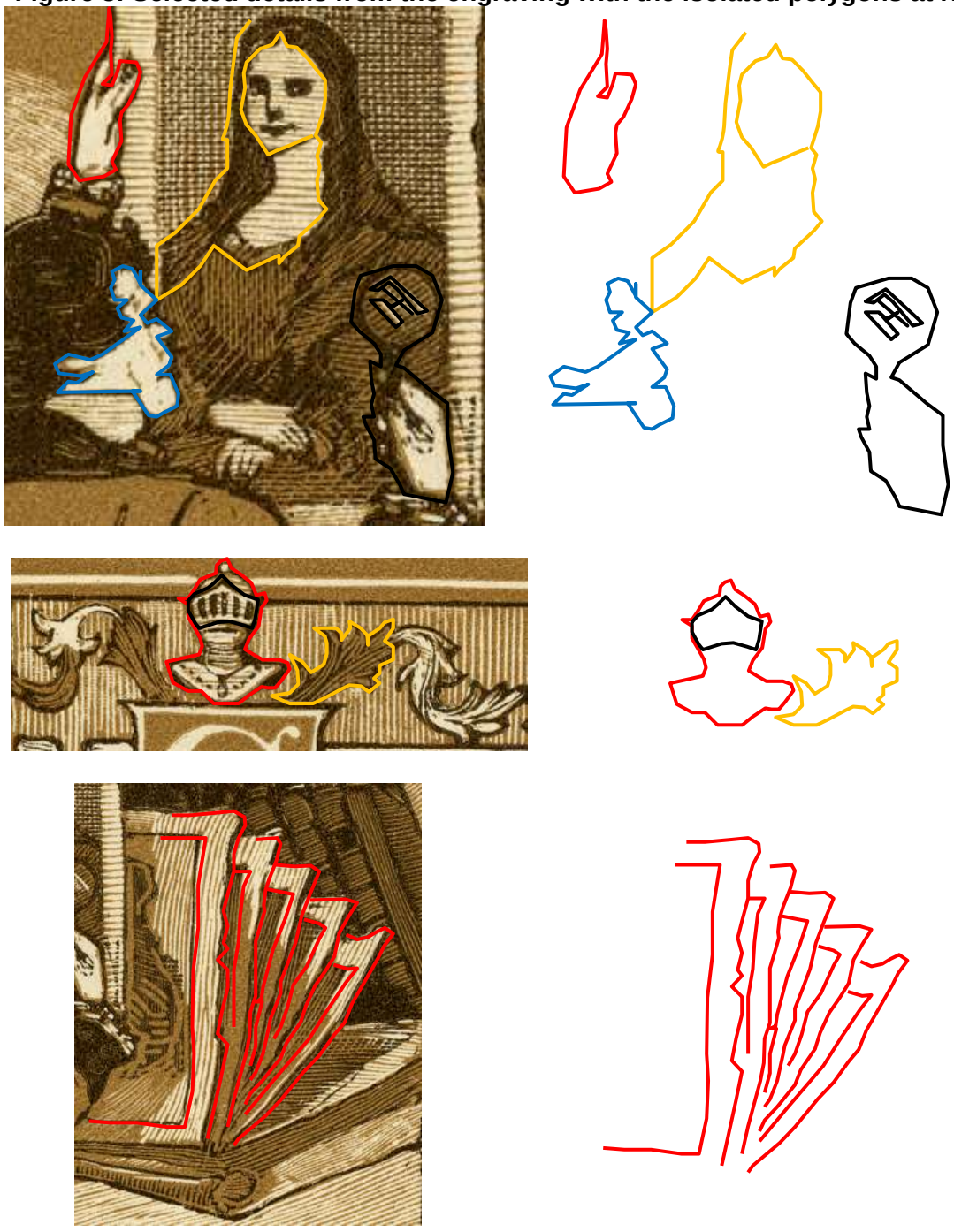
Taking the bookplate (A) as a reference, some areas were defined to be analyzed.

Figure 3: Selected details from the engraving with the isolated polygons at right.



The details of engraving enlargement distinguish the lines and shapes of the image. After comparing the first bookplate with the other ones, the system is able to

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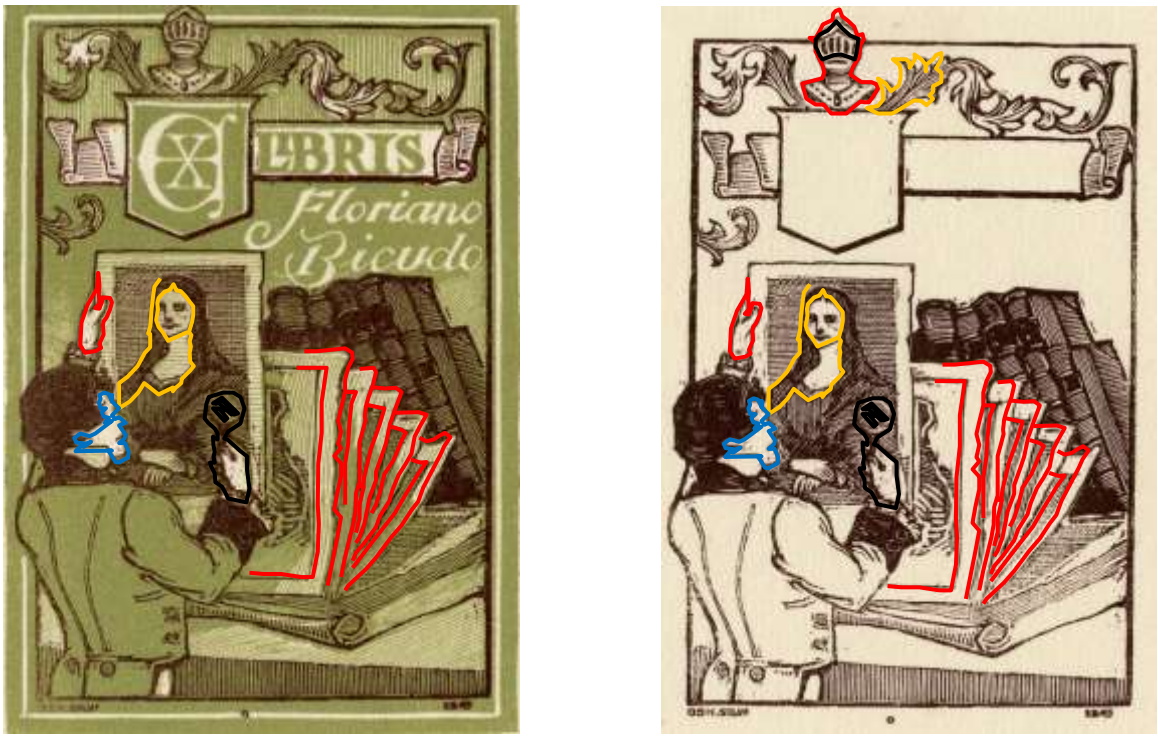
distinguish similarities between samples and recognize that images from (B) to (I) are practically the same bookplate, with few variations in drawings and colors. During the comparison it is necessary to apply an image proportion because some samples may exist in different patterns.

Evidence after comparing the selected polygons and applying the comparison to images (C) and (H).

Figure 4: Polygons in original size and proportional adjust to allow comparison.



(C) (H)

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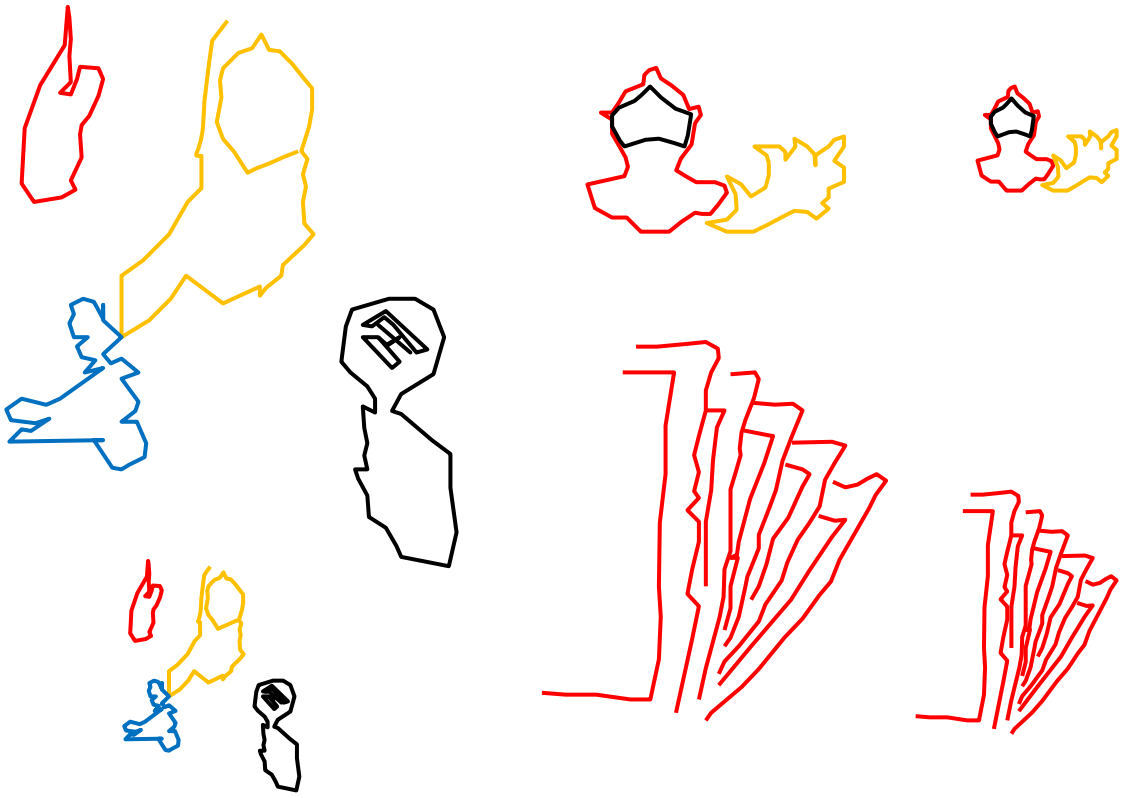

5 CONCLUSION

Biometric techniques are liable to be used in engraving recognition considering that engraving are made through the very same process as fingerprints – both are the result of transferring a drawing by pressing a surface – which makes possible the use of the developed techniques of fingerprints to help in bookplate recognition.

The technology development for biometric recognition associated with digitalization and database storage tend to support the use of these elements as a tool to facilitate image identification and recognition. Bookplates will be digitalized in controlled environments, without difficulties that could impact the fingerprint identification as unclearness, finger pressure, sweat, rotation and other aspects presented in the gathering process. The bookplates will be digitalized in high resolution and stored in structured databases with metadata.

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Clearly, the proposed system will not be the single tool applied to bookplate recognition. Associated with the system, the use of a structured database with metadata to describe the engraver, the owner, the adopted engraving techniques, colors, textures, dimensions, dates, keywords description etc. is highly recommended. This subject research possibility combined with the use of biometric techniques will provide subsidy to a research based on data of the primary source, as well as on artistic elements represented in the stamps, contributing to the iconographic collection organization.

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